development of individuals in Great Britain and New Zealand. Even on continents we may notice the same dearth of ants in cool, humid regions, as, *e. g.*, in the Selkirk Mountains of British Columbia as compared with the Rockies of Alberta. The former mountains, which are very humid and covered with a rich vegetation, have a much poorer ant fauna than the latter, which are drier and have a more meager flora, though sufficiently moist and warm to afford optimum conditions for ants during the summer months.

In addition to a great amount of taxonomic and purely descriptive material Donisthorpe's book contains many original observations on the behavior of ants, especially in the sections devoted to the species of *Lasius* (notably *L. fuliginosus* and *umbratus*) and the blood-red slavemaker (*Formica sanguinea*). The illustrations are excellent and abundant and, with few exceptions, have been specially prepared for the volume. Most interesting are the figures of the gynandromorphs and ergatandromorphs of *Formica rufibarbis, F. sanguinea* and *Myrmica scabrinodis* (Pl. IV. and Figs. 45 and 46) and of the mrymithogyne of *Lasius flavus* (Fig. 47).

The only matter open to criticism in the volume is, perhaps, Donisthorpe's too hasty adoption of the generic name *Donisthorpea* for *Lasius*. The genus *Lasius* was based by Fabricius in 1804 on *Formica nigra* L., the common garden ant, one of the most abundant insects of the northern hemisphere, and since that date universally known, both in technical and popular literature, as *Lasius niger*. In 1914 Morice and Durrant exhumed a paper by Jurine published in 1801, in which the name *Lasius* was assigned to a genus of bees. The authors therefore renamed the ant-genus *Donisthorpea*. It seems, however, that there is serious doubt concerning the status of Jurine's paper, so that we need not be in a hurry to make this deplorable change in our nomenclature. At any rate, it will probably be difficult to persuade the majority of living myrmecologists, including Forel, Emery and the reviewer, to substitute *Donisthorpea nigra* for *Lasius niger*, a name which for more than a century has been almost as much of a household term as *Musca domestica, Equus caballus* and *Canis familiaris*.

W. M. Wheeler

SPECIAL ARTICLES

THE IMPORTANCE OF BACTERIUM BULGARICUS GROUP IN ENSILAGE

This department has been investigating the microbial flora of different kinds of ensilage at various stages of fermentation throughout the past year. The presence of *Bacterium Bulgaricus* group was first observed from the preliminary examinations of miscellaneous samples of ensilage. Since that time several hundred bacteriological analyses have been made from different kinds of ensilage, and at all stages of fermentation. The results obtained offer sufficient evidence to indicate the importance of this *Bulgarian* group in the ripening of normal ensilage. In a review of the literature relating to microorganisms of ensilage, only one reference[1] could be found which mentions the presence of *Bacterium Bulgaricus* group. The reference in question cites ensilage, along with many other substances, only as a source from which *Bacterium Bulgaricus* has been isolated.

Plate cultures, made upon acidulated glucose agar, were used for the cultivation of this group. The acid (1 cc. of a 1 per cent. sterile acetic acid solution) was added directly to the plates and mixed with the glucose agar when the latter was poured into the plates. The cultures were incubated at 35°C. for four days. The media permitted the growth of practically only two groups of microorganisms; the "*acid group*" and *yeasts*. The colonies of the latter were always few in number, if present at all, and with a little practise could be easily differentiated from the *Bulgarian* group.

The *Bulgarian* colonies showed varying degrees of size and form. In size, the colonies appear as very minute forms scarcely visible to the naked eye, to a type as large as the average lactic acid colony, and often larger.

In form, the characteristic "woolly edge" colony was frequent, but the predominating type was very similar to the common *Bac-*

[1] "A Study of *B. Bulgaricus*," P. G. Heinemann and M. Hifferan, *Jour. Inf. Diseases*, Vol. 6, No. 3, June 12, 1909.

terium lactis acidi colony. This type was either lance-shaped or a small round dense colony with uniform edges. A zone of cloudiness encircling the colony was characteristic of this form. The colonies of this group were also often observed and isolated from plain agar plate cultures.

The fact that the colonies of these organisms are very similar in many respects to those of *Bacterium lactis acidi* is probably one reason why this group has been overlooked by other investigators.

Much difference was likewise noted in the morphological features of the different cultures isolated, as well as in the same culture. In size, the organisms vary from small oval rods to well defined rods and filaments.

Detailed studies of many kinds of ensilage were made from the time the material entered the silo and at frequent intervals until ensilage was formed. The following kinds of ensilage were examined: cane, kaffir, cane fodder, alfalfa, and several kinds of ensilage made from the mixture of alfalfa and different carbohydrate materials. In every case the *Bulgarian* organisms were present in sufficient numbers to be very influential in silage fermentation.

TABLE I

Action of Bulgarian Cultures in Plain and Peptone Milk

(Temperature Incubation 35° C.)

(Figures give No. c.c. of N/20 NaOH to neutralize 5 c.c. milk.)

Cultures	After 5 Days		After 10 Days		After 15 Days		After 20 Days		After 25 Days		After 30 Days	
	Plain Milk	Peptone Milk	Plain Milk	Peptone Milk	Plain Milk	Peptone Milk	Plain Milk	Peptone Milk	Plain Milk	Peptone Milk	Plain Milk	Peptone Milk
65S	5.1	11.4	5.5	12.7	8.0	17.0	8.2	17.2	9.0	20.1	11.4	20.1
2X	4.8	11.4	5.1	12.9	6.1	13.1	5.0	12.5	5.7	13.3	11.6	15.5
44S	5.5	11.1	4.6	12.7	8.7	14.5	9.8	15.8	12.7	16.2	12.0	17.8
8S	6.6	6.0	4.0	4.8	5.3	5.8	3.7	5.7	3.7	7.0	4.0	7.7
9S	7.6	6.0	4.0	6.1	6.9	8.2	6.0	9.1	7.5	9.2	9.6	9.5
66S	9.2	13.2	9.2	14.7	12.8	19.3	11.6	19.5	15.3	19.5	15.3	24.4
70	5.8	11.4	5.0	12.8	8.1	14.5	8.3	16.2	11.3	17.6	13.0	19.0
14B	6.4	9.8	5.5	12.3	8.3	16.2	9.2	16.6	11.5	16.5	11.8	20.4
90S	6.3	13.4	7.3	15.1	9.2	16.3	9.7	16.0	11.7	17.3	12.7	19.0
96	7.2	14.3	8.3	13.5	10.8	14.4	10.8	13.9	12.9	16.9	15.5	18.0
CK*	3.5	4.1	3.5	4.1	3.5	4.1	3.5	4.1	3.5	4.1	3.5	4.1

*Check.

On glucose agar slants, the organisms grow very well. The characteristic growth is beaded to effuse in appearance. Glucose appears to favor the growth of the group. A good growth is observed in one to four days in glucose broth inoculated directly from a colony, while on the other hand, a litmus milk culture from a similar origin is coagulated only after two to fourteen days' incubation. Peptone added to the milk favors their growth; coagulation and acid production being much more prompt. The acidity produced by the different organisms in milk varies from 0.9 per cent. to 2.5 per cent., calculated as lactic acid.

The rate and amount of acidity produced from a few cultures, growing in plain and in 1 per cent. peptone milk respectively is shown in Table I.

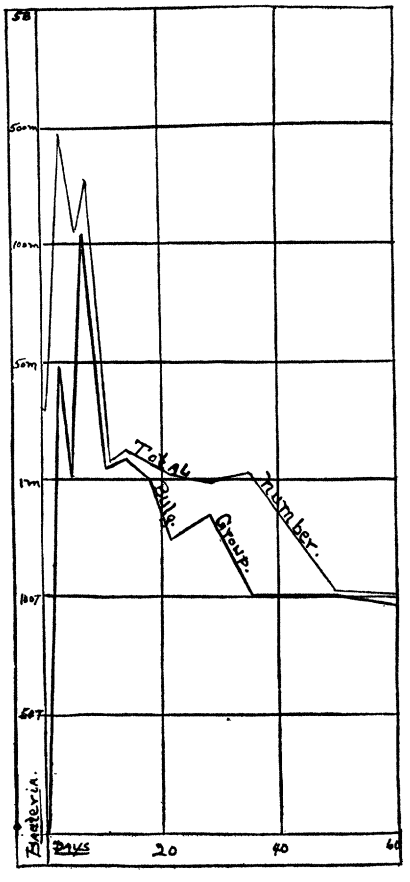
In Fig. 1 may be found curves plotted from the data obtained from kaffir silage. The table is self explanatory, showing the relation of the total *Bulgarian* organisms to the total microbial content throughout the ripening process of the ensilage. The ensilage was considered very good. The acidity[2] as it entered the silo was 0.18 per cent., figured as lactic acid. The final acidity was 2.07 per cent., of which 1.36 per cent. was non-volatile.

[2] The total acidity was determined by the method proposed by Swanson, Calvin and Hungerford, *Journal of the American Chemical Society*, Vol. XXXV., No. 4, April, 1913.

calculated as lactic acid, while 0.71 per cent. was volatile[3], figured as acetic acid. Plain agar was used to obtain the total microbial content. The relation of these two curves to each other compares very favorably with the corresponding curves made from other kinds of ensilage studied.

Fig. 1.

A Comparison of Total Numbers with the Bulgarian Type in Kaffir Ensilage



The presence of this group, in all normal ensilage, in large numbers, at a very important stage of fermentation, together with the fact that their characteristic fermentation is acid production, seem to offer sufficient evidence to support the view that a large part of the acid formed in normal ensilage is the result of their activities.

A more detailed report relating to silage fermentation will appear later.

O. W. Hunter
L. D. Bushnell
Department of Bacteriology,
Kansas State Agricultural College

[3] The volatile acids were determined by the method proposed by Dox and Neidig, *Research Bulletin*, No. 7, Experiment Station, Iowa State College.

THE ANNUAL MEETING OF THE AMERICAN PHYSICAL SOCIETY

The eighty-first meeting of the American Physical Society was held at Columbus, Ohio, December 27–30, 1915. It was the annual meeting and a joint meeting with Section B of the American Association for the Advancement of Science. Six sessions were held for the reading of papers. President Merritt presided, except on Wednesday afternoon, which was devoted to a special program of invited addresses arranged by Section B. Vice-president E. P. Lewis was in charge of this session. At the other five sessions the following sixty-three papers were presented:

"A Mechanical Device for the Rapid Evaluation of Certain Variable Exponential Functions," by Irwin G. Priest.

"On the Value of $\gamma = Cp/Cv$ for Hydrogen," by Karl K. Darrow.

"Deviation of Natural Gas from Boyle's Law," by R. F. Earhart.

"Preliminary Report on the Diffusion of Solids," by C. E. Van Ostrand and F. P. Dewey. (By title.)

"On the Properties of Matter at Low Temperatures," by Jakob Kunz. (By title.)

"Pressures and Critical Lengths in the Collapse of Short Tubes," by A. P. Carman.

"A Photographic Study of the Relative Velocity of Sound Waves of Different Intensities," by Arthur L. Foley.

"A Preliminary Investigation of an Explosion Wave in a Gas," by J. B. Dutcher.

"An Attempt to Detect a Change in the Specific Heat of Selenium with a Change in the Illumination, and also with the Application of an Electric Field," by L. P. Sieg.

"Wind Velocity and Elevation," by W. J. Humphreys.

"A Proposed Physical Method for Reducing Radiant Power and its Luminous Value," by Irwin G. Priest and Chauncy G. Peters.